DIY

Worthwhile projects you can build on your own

DDRR antenna for 2 meters

Through the years, the military has developed a series of antennas that were both effective and low-profile. In other words, they needed an antenna that could perform well, but didn't stick out from ships or aircraft, and expose themselves to damage from speed and drag. Enter the ***DDRR*** (directional discontinuity ring radiator, or sometimes, direct-drive ring radiator) antenna. It's also been called a *halo antenna* and *hula-hoop antenna*.

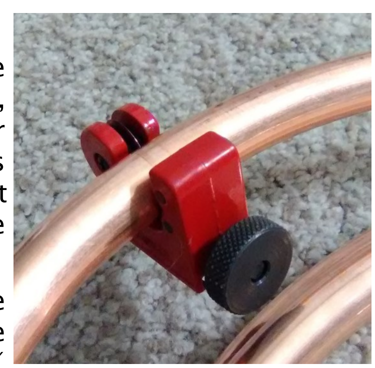
The DDRR antenna was featured one time in an issue of *QST* (Dec 1971, p. 28–32), and even in the *ARRL Antenna Book* (21st Edition, p. 21-4B), but has, for some mysterious reason, been removed from the latter. This antenna was brought to my attention by Gavin Grow K9GKG, and it's been a curiosity ever since. Because there's not a lot of literature confirming how well the antenna actually works on 2 meters, I had to try it for myself. So, this DIY is more of my own experimentation than an actual "let-me-show-you-how-to-make-one" article.

The effectiveness of the DDRR antenna derives from its ground plane, which can be either a parallel copper tube or a flat metal surface, like that on a vehicle, steel ship hull, or aircraft fuselage. While the antenna ground plane can be made using even chicken wire, I chose the sheet metal (pizza pie tin) method for simplicity. If you think about it, the DDRR antenna looks like a copper J-pole that's bent into a circle. As a result, the DDRR antenna allegedly ends up with a unheard-of bandwidth of 12 MHz, owing to the large diameter of the copper tubing. Let's find out whether that holds true in our case.

Parts list

- One 10-foot ½″ copper tubing, pre-coiled
- Two ½″ copper caps
- One 2-foot long ¾″ PVC Schedule 40 pipe
- One SO-239 bulkhead connector
- One 12″ pizza pie tin
- One 50 pF 1000 V capacitor
- One ½″ to ½″ copper elbow
- One 1″ length of ½″ copper tubing
- One 4″ 12 AWG solid copper wire
- Small 1-¼″L-bracket, screws, nuts

Construction



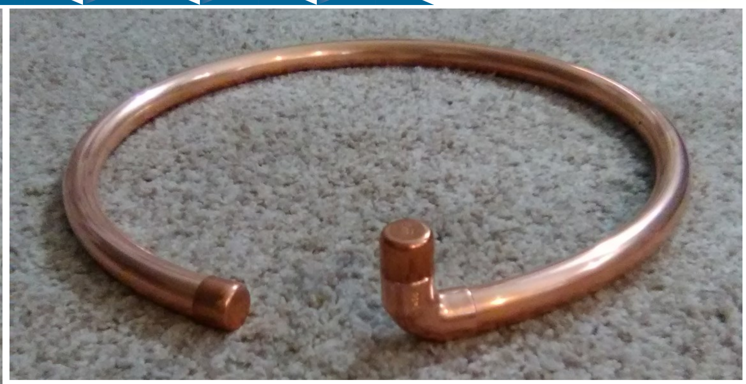
Before getting started, understand that this project requires the soldering of copper pipe. If you've never soldered copper piping, either find somebody with some experience, who can help you, or make this your opportunity to learn a new skill. Since that requires working with an open-flame torch, soldering copper pipe can get dangerous, if you're not used to it. Also, I recommend cutting the copper pipe with a hand pipe cutter rather than a hacksaw.

Begin by cutting a 33-inch length of the coiled copper tubing. Due to the circular shape of the tubing, it might be easier to measure the length with a measuring tape, than a tape measure. Cut 1-¼″ off the straight copper tubing. Place a cap over one end of the 33-inch coiled tubing, and the elbow over the other. Insert the 1-¼″ straight tube into the elbow. Place the second cap over the 1-¼″ straight tube. You might not be able to see much of the 1-¼″ tube afterwards.

DIY, continued

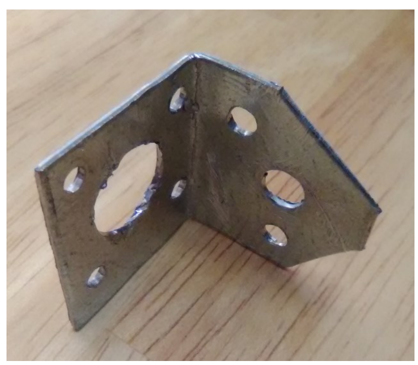
DDRR antenna for 2 meters

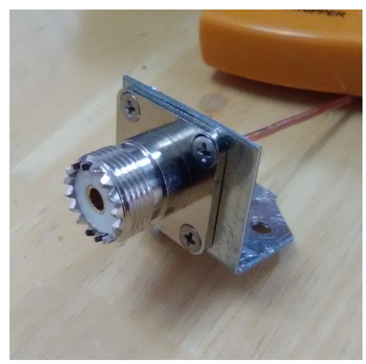
Freshly cut 33-inch ring



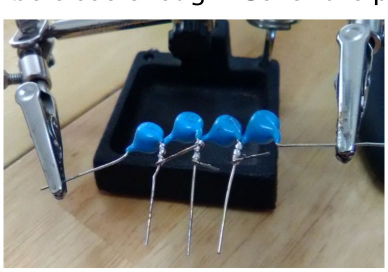
Fully assembled ring, with the vertical section, elbow, and caps

Fashion a metal L-bracket from a piece of 1-¼″ wide sheet metal. That width allows the bracket to hold the SO-239 bulkhead bolted to it, without interfering with the antenna itself. Drill a 7/16″ hole in the bracket to hold the bulkhead, allowing room for the four support screws. Insert the bulkhead into the 7/16″ hole to measure the screw hole placements, drill out the four holes (5/32″ bit), and apply the screws and hardware (I used a M3-0.5x8 mm flat head screw, with an accompanying M3 split washer and a M3-0.5 nut for each of the four holes.)





This antenna needs a 50 pF capacitor to terminate the end of the ring opposite the feed point end, to match its inductance. But, I only had some 220 pF high-voltage capacitors around from a previous project, so I soldered four of them in series (220 pF ÷ 4 = 55 pF), and that should be close enough. Cover the package with heat shrink tubing for looks and protection.

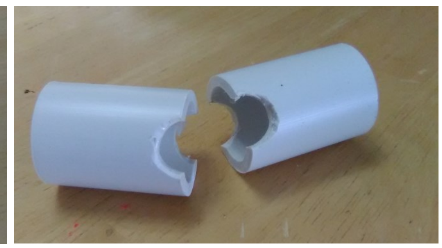


DIY, continued

DDRR antenna for 2 meters

Strip the 12 AWG solid wire bare, then solder one end to the rear barrel of the SO-239 bulkhead center pin. Drill two #8 holes in both the bracket and the pizza tin at one edge, and install the bracket onto the bottom side of the pizza tin using #8 screws, split washers, and nuts.

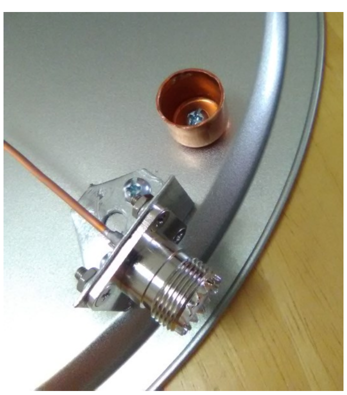
Fashion four PVC standoffs by cutting two 3″ sections of the ¾″ PVC. In the side wall of each 3″ piece, drill a ½″ hole in the very center, then cut each 3″ tube in half, right through the hole. These will be used to hold the copper pipe ring to the pizza tin.

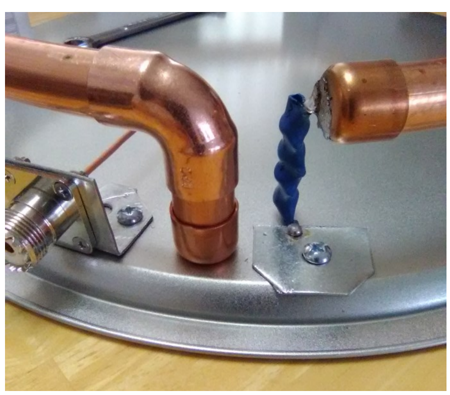


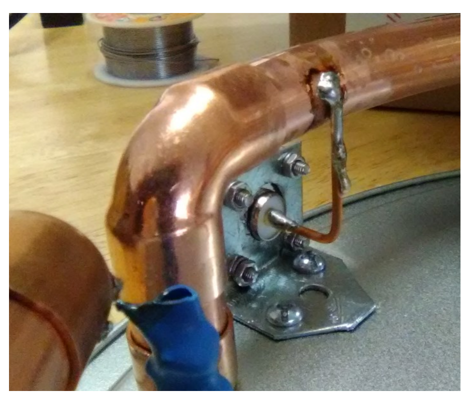
Drill a 5/32″ hole in the copper cap at the end of the 1-¼″ straight copper pipe, and another through the pizza tin, where the cap will sit, about 1-¼″ from the center pin of the SO-239 bulkhead. Attach a #8 x 3/8″ screw through the copper cap and pizza tin, then tighten a split washer and nut to the inside of the pizza tin.

Insert the copper ring assembly back into the copper cap that you bolted to the pizza tin, and copper-solder all the joints in place and allow the assembly to cool. Drill another 5/32″ hole in the pizza tin just below the other end of the copper ring, and install another #8 screw, split washer, and nut there, for the capacitor. Attach one end of the capacitor to the pizza tin, and solder the other end to the copper cap on the end of the copper ring.

Bend the 12 AWG bare wire of the SO-239 bulkhead upward, then solder it to the nearest point of the copper ring assembly. Hot-glue (or similar) the PVC standoffs to both the pizza tin and the copper ring assembly.

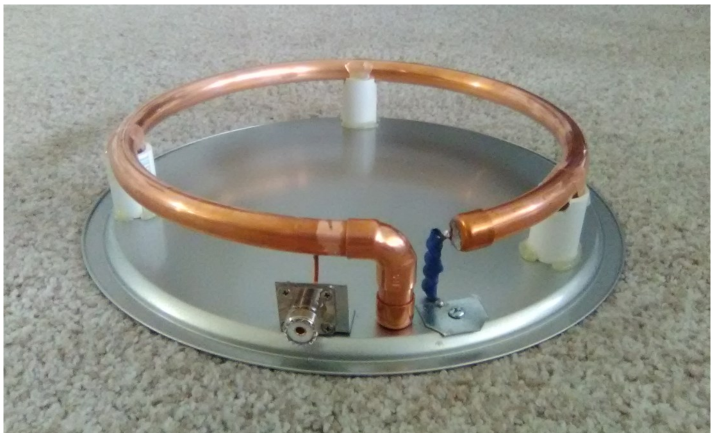






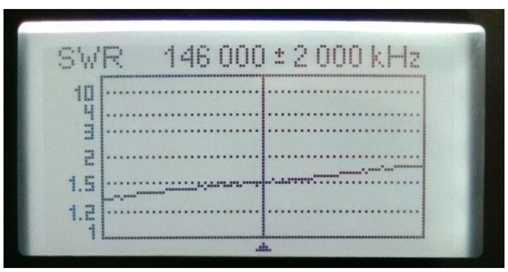
DIY, continued

DDRR antenna for 2 meters



The completed antenna, side view

Top view →



The initial testing was a bit frustrating, since it appeared that the SWR was completely off the chart for the 2-meter band. But getting it off the floor and onto a wooden chair, plus another adjustment, barely brought the antenna back into working territory, telling me that the antenna is quite sensitive to change in height and proximity to nearby conductors, including my hands. Because of this, it's my opinion that attempting to build the DDRR antenna for 2 meters is not for the novice.

Semi-technical analysis

It turns out that the DDRR antenna is a glorified rubber duck, or in this case, copper duck, but resembles a "magnetic loop" antenna, especially with a theoretical gain of around 1.5 dBd. The actual radiating element is the short 1-¼″ vertical pipe that connects the top tube to the ground plane. The top tube serves as the loading inductance, making the antenna a vertical radiator, producing a vertically polarized signal on 2 meters, with the magnetic fields of the copper tube and the ground plane largely canceling each other. So, technically, the DDRR antenna seems to more of a "leaky slot" antenna, rather than a "lazy J-pole" antenna. In the end, this makes for a very *inefficient* antenna.

The DDRR antenna was originally designed for use on 20 meters, 40 meters, and 80 meters by Dr. Joseph M. Boyer, and was first de-classified and published in *Popular Electronics* (07-1963, p. 25–30), and later in *73 Magazine* (Issue 117, 06-1970, p. 20, labeled "Expensive, difficult-to-build, mediocre antenna"). While it's possible to build a DDRR antenna for HF, it's rather large and unwieldy, becomes quite expensive ($2000 to $3000), and has been shown to produce broadband TVI locally when mounted for horizontal polarization. Also, the heavy currents through the tubing can result in over 50 kV between them near resonant frequencies.

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